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ESTIMATING EFFECT OF TIMBER HARVESTING LEVELS ON EMPLOYMENT IN WESTERN UNITED STATES

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ABSTRACT

Discusses and presents methods for predicting changes in employment in wood products industries, and total community employment, as the level of timber harvesting rises or falls.

KEYWORDS: employment impacts, timber harvesting.

Forest Service administrators have traditionally been concerned with the stability and economic welfare of communities and individuals near the National Forests. Such statements as "provide public services, income, jobs, and amenities in rural areas..., seek opportunities for development of forest based enterprises..., and identify and promote opportunities for community development," (USDA Forest Service 1974) describe Forest Service concerns. How these concerns should be incorporated in the decision-making process and environmental impact statements is not well established.

This note discusses one aspect of economic welfare, employment, with respect to timber harvesting decisions. It will identify situations in which harvest decisions will affect employment, predict employment changes in the wood products industries because of changes in timber harvest, and show the effect of changes in this employment on employment in other sectors of the local economy. Timber and land-management planners can use the suggested procedures to portray the employment effects of alternative harvest levels.

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WHEN TO CONSIDER EMPLOYMENT EFFECTS

Whether a proposed action significantly affects local employment depends upon a number of criteria. First, does the proposed action actually change the harvest level or only the limits on the harvest level? For instance, an increase that cannot be sold because of budget restrictions will not affect the amount being cut unless the budget is increased and buyers are available. No change in harvest will have no effect on employment.

The second consideration is the relative importance of the agency or firm providing timber to industry. If the industry receives a large proportion of its raw material from one forest owner, then changes in harvest level by that owner will have considerable effect on the industry, even with some substitution from other sources. Table 1 shows for selected Oregon counties the proportion of the total harvest provided by National Forests that is processed by the forest products industry. For counties such as Baker and Crook, changes in National Forest harvest may be critical because industry appears to have few alternative sources of timber. When does the proportion of a total harvest provided by one firm or agency become critical? My experience indicates that industry shows concern when more than 40 to 50 percent of its raw material is supplied by one source.

The final consideration is the percentage of local employment provided by the forest products industry. If the industry provides a small portion of total employment, changes in its employment will have little effect on the community. "Substantial portion" can be difficult to define; however, the forest products industry is generally regarded as a major employer in any county where it employs 20 percent of the work force. Figure 1 identified counties in the western United States in which the forest products industry provides, 10, 20, and 30 percent of the total employment as determined by the 1970 Census of Population. The critical counties are located in western Montana, northern Idaho, Washington, Oregon, and northern California.

Impact on timber supply, proportion of timber supply, and significance of wood products labor force--these criteria can indicate how harvest flows will affect employment. When an alternative affects a major portion of the local timber supply and the wood products industry provides a significant amount of the local employment, then a detailed study of the employments effects is warranted.

Table 1.--*Oregon counties in which National Forests supplied more than 50 percent of the timber processed by primary wood products industries in 1972 (calculated from Schuldt and Howard 1974).*

County	Total wood processed	National Forest
	M bd. ft.	*Percent*
Baker	102,293	90
Clackamas	352,573	63
Crook	156,000	94
Curry	202,924	73
Deschutes	214,000	69
Grant & Harney	297,754	91
Hood River	90,111	61
Lake	117,400	60
Umatilla & Morrow	109,197	55
Union	196,409	69
Wallowa	35,760	71

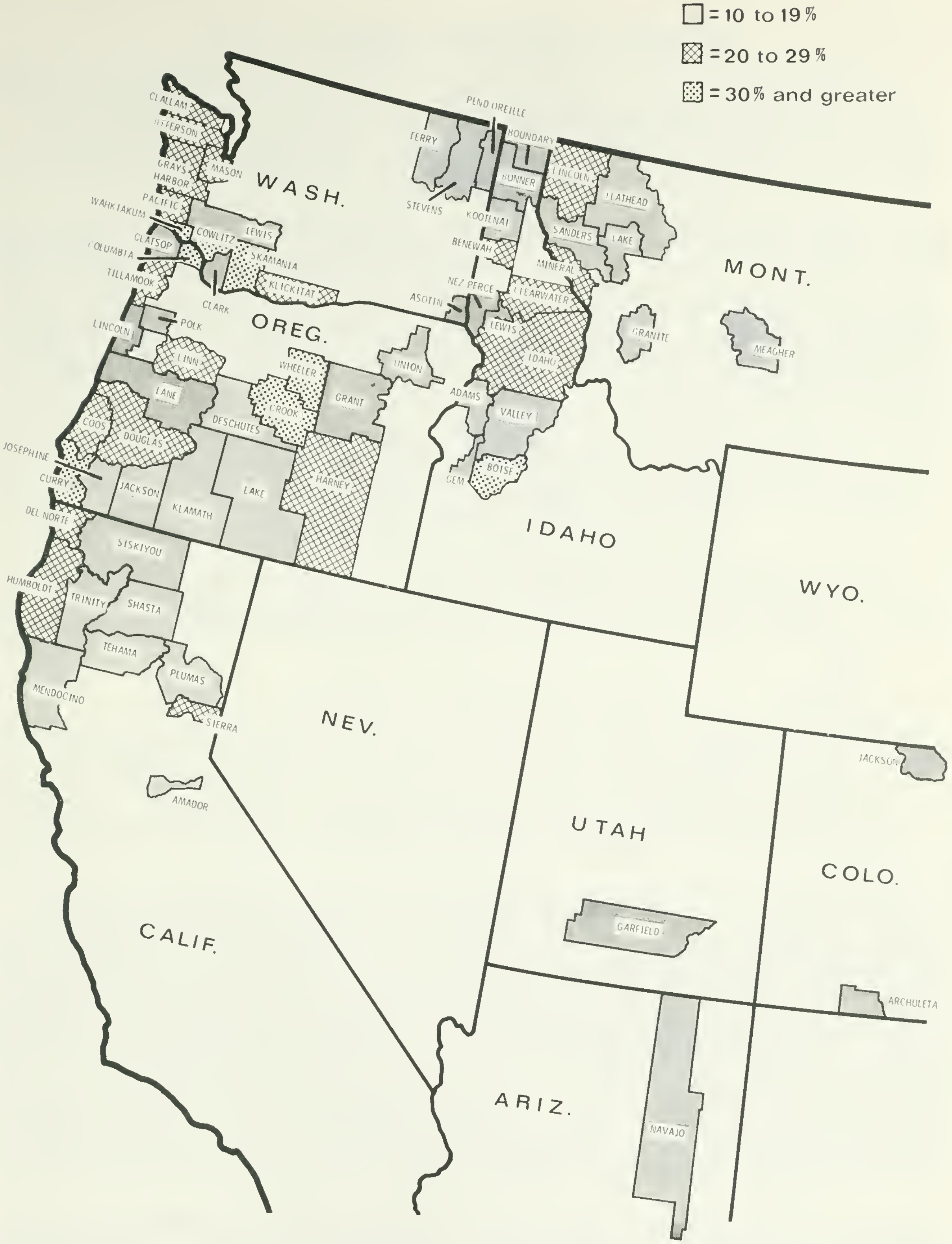

Figure 1.--Counties where wood products and paper industries provide 10 percent or more of all employment.

CALCULATING FOREST INDUSTRY EMPLOYMENT EFFECTS

In forest industries, labor can be expressed as the number of employees required per million board feet of timber processed. (Wall and Oswald 1975). This ratio can be used to estimate the number of employees that could be supported by a specific harvest level. Because it is derived by dividing total employment into total timber input, the ratio of employment to wood consumption is an average.

Table 2 shows employment-wood consumption ratios derived from various sources for States where forest products industries provide a major source of employment. To use these ratios, one estimates the expected change in harvest measured in log scale and multiplies this figure by the ratio for the area being considered. The result is the change in employment for the primary forest products industry. For example, if one alternative produces a 2 million board-foot reduction in National Forest harvest in western Oregon, then the number of primary processing jobs affected would be approximately 2 by 6.6 = 13.2.

Table 2.--*Average forest products industry's employment-input ratios for selected western States. (Calculated from: Idaho - Schuster and others 1975; California, Oregon, and Washington - Wall and Oswald 1975; Montana - Johnson 1972; using the procedure for published data shown in the appendix.)*

State	Ratio - employees per million board feet local scale
Idaho	7.0
California	5.7
Montana	6.0
Oregon - Eastern	6.1
Western	6.6
Washington - Eastern	6.8
Western	8.6

The employment-wood consumption ratio must be used with care when predicting employment changes. First, estimates of employment changes are based on changes in harvest of a single agency or National Forest as in the example just presented. This assumes that there will be no substitute wood supply. In cases where there is little private timber, where the industry is dependent on public timber, and where timber cannot be easily imported, this assumption may be valid. However, a recent unpublished study indicated that in the western pine region a 25 percent reduction in the supply of National Forest timber would be partly offset by a 10 percent increase in private harvest over the shortrun. (Darius M. Adams, 1976. Further simulations of the price effects of shifts in National Forest timber harvest schedules. Unpublished report on file at the Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.) Instead, prediction of employment changes should be based on estimates of changes in total local timber supply if it can be estimated.

Second, one must assume that the employment-wood consumption ratio represents all the wood products plants in a local area. This may not be the case. Employment-wood consumption ratios vary by industry (sawmills, logging, veneer mills, etc.), by location, and by individual firm. These problems can be avoided by calculating employment-wood consumption ratios for the local mills rather than using the figures in table 2. Furthermore, changes in harvest size or quality may affect different sectors of the primary wood products industry in different proportions. A detailed discussion of the procedure can be found in the appendix.

A third assumption is that employment-wood consumption ratios change little over time because of the slow rate of technological change. This is a safe assumption for the short run; however, long-range projections may warrant some adjustment. A weighted composite of the data presented by Wall and Oswald (1975) for California, Oregon, and Washington indicates that the average reduction in the employment-wood consumption ratio is approximately 10 percent per decade. Again, this average can vary by industry, with logging showing the least change over time.

Fourth, one must assume that the wood consumption associated with the marginal employee--the last hired or the first fired--is the same as the average wood consumption per employee. This is probably not true for the industry as a whole and may not be true for individual firms. Variations in employment-wood consumption ratios between firms are known to exist and lack of variation in an individual firm would require stringent conditions concerning the production functions and the relative unit values of employment and wood consumed. Unfortunately little or no research has been done to show the error in employment projections caused by assuming that the marginal and other employees are similar in wood consumption. For those unwilling to make this assumption, a procedure avoiding it is presented in the appendix under calculation of a marginal employment-wood consumption ratio using original data.

Together these assumptions indicate that employment-wood consumption ratios must be used with care. However, for situations in which little data are available or the data are costly to obtain, ratios shown in table 2 indicate how timber supply may affect employment.

ESTIMATING SECONDARY EMPLOYMENT

Basic industries are those that provide income and jobs to the community through exports; this income and employment, in turn, generate income and employment in nonbasic industries, those that serve the local community. Thus, the economy is assumed to be dependent on the basic industries for its existence. Although this view might be questioned, many "ghost" towns in the West were created when basic industries such as mines or sawmills closed down. Generally wood products industries are considered to be basic.

The relationship between employment in the basic and nonbasic industries in the local economy is commonly expressed by means of a ratio called "the employment multiplier." This multiplier is useful in predicting the effects employment changes will have on community employment. To do this, one calculates the change in a basic industry and multiplies this change by the employment multiplier to get the change in community employment. For instance, the example in the previous section showed that a 2-million-board-foot decrease in the harvest reduced the number of wood products industry positions by 13 in western Oregon. Thus, if this reduction in basic industry employment opportunities occurred in Coos County with its multiplier of 2.46, the total number of positions that might be eliminated by this reduction would be 2.46 by 13 = 31.98. Thirteen of these positions would occur in the wood products industry and 19 would be in service industries such as retail stores, gas stations, clinics, schools, and so on. One can assume that the multiplier remains fairly constant over time (Tiebout 1960).

There are numerous ways of defining basic and nonbasic employment and calculating the employment multiplier. One way is to define certain industries such as agriculture, mining, and manufacturing to be basic because they usually ship most of their production outside the local area. Convery (1973), for example, has advocated this technique using published data for small rural communities where these industries are almost always the basic ones. This technique is illustrated in table 3, which provides employment multipliers for counties where the wood products industries employed at least 10 percent of

Table 3.--*Wood products employment and employment multiplier by selected counties for 1970 in western United States*

County by State	Wood[1] products employees	Multiplier[2]
Alaska (Districts)		
Haines	136	3.04
Ketchikan	636	3.68
Outer Ketchikan	54	2.31
Prince of Wales	565	1.30
Sitka	626	3.08
Wrangell-Petersburg	464	1.83
Arizona		
Navajo	1,236	3.73
California		
Amador	452	3.69
Del Norte	1,200	2.76
Humboldt	7,193	3.25
Mendocino	3,302	3.26
Plumas	678	3.97
Shasta	3,454	4.43
Sierra	189	2.96
Siskiyou	2,279	2.87
Tehama	1,897	2.58
Trinity	458	2.91
Colorado		
Archuleta	169	2.40
Jackson	79	2.25
Idaho		
Adams	159	2.29
Benewah	499	2.29
Boise	186	1.77
Bonner	904	3.07
Boundary	350	3.00
Clearwater	789	3.06
Gem	609	1.99
Idaho	865	2.23
Kootenai	1,229	3.44
Lewis	158	2.36
Nez Perce	1,679	3.59
Valley	223	3.17
Montana		
Flathead	1,433	3.36
Granite	162	2.32
Lake	459	2.86
Lincoln	1,572	2.68
Meagher	158	1.80
Mineral	255	3.10
Sanders	424	2.63
Oregon		
Clatsop	1,156	3.08
Columbia	3,008	2.29
Coos	5,885	2.46
Crook	1,162	2.14
Curry	1,460	2.09
Deschutes	1,710	3.70
Douglas	6,803	2.49
Grant	400	2.37
Harney	697	2.04
Jackson	4,385	3.65
Josephine	1,845	3.26
Klamath	3,181	2.78
Lake	382	2.23
Lane	13,401	3.64
Lincoln	1,554	3.47
Linn	5,603	2.35
Polk	1,747	3.08
Tillamook	1,469	2.37
Union	954	3.62
Wheeler	237	1.69
Utah		
Garfield	132	2.85
Washington		
Asotin	747	3.54
Clallam	3,094	2.78
Clark	5,834	3.09
Cowlitz	8,087	2.28
Ferry	147	2.03
Grays Harbor	5,776	2.58
Jefferson	928	2.94
Klickitat	1,016	2.38
Lewis	3,007	2.89
Mason	1,702	2.51
Pacific	1,451	2.19
Pend Orielle	263	2.73
Skamania	588	2.15
Stevens	730	2.67
Wahkiakum	464	1.69

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[1] Calculated from: Ashby, L. D., and D. W. Cartwright. 1975. Regional employment by industry 1940-1970. 542 p. U.S. Dep. Comm., Bur. Econ. Anal.

[2] Calculated by dividing total county employment by the sum of the employment in the agriculture, mining, and manufacturing industries and the federal military. Employment data were taken from the citation in footnote 1.

employment. The multipliers were calculated from the 1970 Census of Population (Ashby and Cartwright 1975) by dividing the sum of the county employment in the agriculture, mining, and manufacturing sectors plus the Federal military into the total number of employees in the county. For instance, in Coos County, Oregon, in 1970, employment was as follows: agriculture (967), mining (17), manufacturing (6,960), and Federal military (340). The sum of these sectors (8,284) provides an indication of the basic employment. This figure divided into the total county employment of 20,402 produces the employment multiplier of 2.46 as shown in table 3.

A more accurate way of identifying the basic employment is by determining the proportion of products that each firm exports through a survey of individual firms in a community. Multiplied by a firm's total employment, this proportion will show the basic employment of that firm, assuming employment is proportional to production. Dividing the community's total employment by its basic employment, will provide an accurate multiplier.

The location quotient (Tiebout 1962) provides another method for defining basic employment using published data. The quotient is calculated by dividing the proportion of total employment an industry provides locally by the proportion that industry provides over a larger region, usually the Nation. If this quotient is greater than one, then some of the local industry's employment is basic. For example, in Clackamas County, Oregon, in 1972 the lumber and wood products industry provided 7 percent of total employment, whereas nationally this industry provided only 1 percent of total employment. The location quotient would be the ratio of these percentages or 7:1. The difference in these percentages (6 percent) multiplied by the total county employment provides the number of basic employees in the lumber and related wood products industry.

This procedure would be repeated for all other industries in the county. The total employment of the county divided by the sum of the basic employees in all industries is the employment multiplier. Data for this technique are available in publications such as the U.S. Bureau of the Census *Census of Populations* and *County Business Patterns*. Maki and Schweitzer (1973) have used this technique in forestry to calculate community dependency.

This technique has certain weaknesses. The multiplier derived from the location quotient is usually too large (Tiebout 1962). Similar techniques have been developed to overcome this problem, but have not received widespread usage.

Furthermore, the size of the multiplier is influenced by the degree of aggregation used in the industrial classification. For example, if all wood products industries are grouped together, the multiplier is apt to be larger than if the multiplier is calculated separately for such industry groups as sawmills, planing mills, logging, and so on. A more serious problem is the assumption that product demands of the local economy are the same as those of the national economy. This is seldom the case in small rural communities, and thus the method may not be applicable here.

A much more complicated and expensive technique for arriving at a multiplier is an input-output study. This technique generally involves a detailed survey of transactions in the local community to determine the inputs and outputs required by each industry in dollar terms. Then summaries of these interactions in the economy are usually calculated in terms of income, which then must be converted to employment to obtain the desired multiplier. Because of the complexity of this technique, interested readers are referred to Darr and Fight (1974) for an example of how to use it in forestry, and to Miernyk (1965) for a complete discussion of the technique and its use.

Input-output studies are generally not transferable. Each local economy is usually so unique that direct transfer may be misleading. Furthermore, even if a study has been done for the county, the wood products industry may not be explicitly identified. Where available with industries suitably defined, input-output studies may provide the best indicators of employment multipliers, but generally it is not feasible to develop one just to show timber industry impacts because of the time and expense involved.

Which of the above techniques is used to calculate the employment multiplier depends upon the time and money available and the precision required. Generally, time and money are too restricted for an input-output study. However, if a current study defines the forestry sectors adequately for the relevant region, then it should be used. The most desirable alternative to an input-output study would be a survey of basic employment. This approach also may require more time and money than is available and force the use of published data. For large communities, the service, manufacturing, and raw material sectors all export some commodities; none are entirely basic industries. Thus, it is usually most practical to use the location quotient method even though it overestimates the multiplier. For small rural communities, the technique that simply defines certain sectors as basic provides an adequate indicator of the employment multiplier for most forestry planning situations. The sectors usually defined as basic are the agriculture, mining, and manufacturing sectors; Federal and State employees are often added if known, because their incomes come from an external source.

CONCLUSIONS

Impact of timber management decisions on community employment should be considered when harvest levels will fall, the substitute timber supply is small, and the wood products industry provides a significant proportion of the community's employment. The change in wood products employment from changing timber supply can be calculated by multiplying the employment-wood consumption ratio by the change in quantity supplied. This ratio may be derived from data gathered locally or from published sources. The effect of changes in wood products industry employment on employment in the community is measured by a multiplier. That may be calculated from an input-output analysis, by location quotients, or by simply defining certain industries as basic. In all cases, care must be taken not to attribute excessive precision to the employment impact analysis.

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APPENDIX

Calculating Employment-Wood Consumption Ratios

Two approaches for generating employment-wood consumption ratios are outlined and illustrated below: (1) a fast and cheap method using published data, and (2) a more expensive, time-consuming, and precise one using original data.

Using Published Data (This approach follows that outlined by Gamache in Mason and others [1974] and is used for the calculations in table 2.)

Step 1.--From the equations presented in Wall and Oswald (1975) for Oregon, we get the following ratios for employees per million board feet.

Industry	*Ratio*
Logging	1.46
Sawmills & planing mills	3.49
Veneer and plywood	6.44

Step 2.--From Schuldt and Howard (1974) for Oregon or local Forest data, we get the distribution of the National Forest harvest.

Industry	*Volume (mm bd. ft.)*	*Percent of total*
Sawmill, planing mills, etc.	322,914	77
Veneer and plywood	96,089	2
Total	419,003	100

Step 3.--Assuming changes in harvest will be distributed to the mills in the same proportion as the present harvest, we derive a combined employees per million board-foot ratio:

$$\underset{\text{(logging)}}{1.46} + \underset{\text{(sawmills)}}{0.77 \times 3.49} + \underset{\text{(veneer)}}{0.23 \times 6.44} = \underset{\text{(ratio)}}{5.63}$$

In some cases, employment for pulpmills may also be added if they absolutely depend on the local residues from the veneer and sawmills for wood input. Generally, they have alternative wood supplies so that pulp production and thus employment will probably not change with changes in local harvest.

Using Original Data

Step 1.--From a survey of individual mills, determine the average annual consumption of wood and average annual employment. Divide the number of employees by the amount of wood used to get the average employment-wood consumption ratio for each mill such as is shown in the fictitious example below.

Firm	*Ratio*
Average of eight local loggers	1.5
Silesia Milling Co.	3.0
Sidney Scrag Mill	2.1
Porter Veneer and Plywood, Inc.	8.6

A better procedure if the data can be obtained is to calculate the marginal rather than the average employment-wood consumption ratio. This could be obtained by observing the effect on employment of year-to-year changes in mill inputs, assuming no change in technology. Or it could be arrived at by asking the mill operator how employment would change with a given change in his wood supply.

Step 2.--Estimate the proportion of increase or decrease in harvest going to each mill. This could be done on the basis of past harvest or it could reflect mill bidding power or the type of raw material involved. For the example, we will assume a decrease in the number of large logs will prevail.

Firm	*Past harvest (percent)*	*Anticipated harvest (percent)*
Silesia Milling Co.	30	40
Sidney Scragg Mill	20	20
Porter Veneer & Plywood, Inc.	50	40

Step 3.--Apply the same principles as in the previous step 3.

$$\underset{\text{(logging)}}{1.5} + \underset{\text{(sawmills)}}{(0.4 \times 3.0 + 0.2 \times 2.1)} + \underset{\text{(veneer)}}{0.4 \times 8.6} = \underset{\text{(ratio)}}{6.6}$$

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